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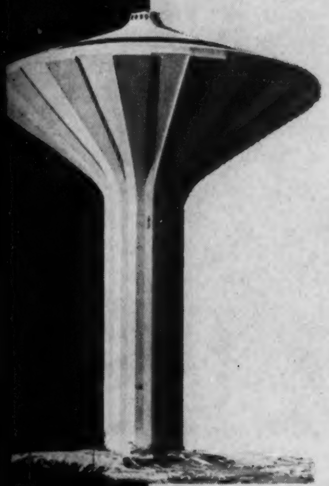

ARTICLES

CONCRETE SPECIFICATIONS

. . . their Interpretation and Administration[1]

By STANTON WALKER[2]

IT GOES WITHOUT SAYING that the best type of specification is that which is most protective of the public interest—and that includes both the producer and the consumer. Specifying the quality of concrete—a product manufactured immediately before use—presents problems not found for most other building materials. Steel, lumber, masonry units, etc., can be tested before they are used: In the case of concrete, only its ingredients can be tested in advance; the concrete itself cannot. Further, and uniquely, the user of concrete is jointly responsible with the manufacturer for its quality. Specifications, their interpretation and administration, must take into account this joint responsibility.

division of responsibility

It should be made clear that this discussion is pointed almost entirely to ready mixed concrete. It is the ready mixed concrete industry that has highlighted the importance of specifications for concrete. Before the predominance of ready mixed concrete, the buyer-seller relationship which now prevails did not exist. In the typical case the buyer and the seller were the same; that is, the contractor mixed his own concrete. There was not the incentive for the buyer to police the seller as there is now, with identities so distinctly separated as those of the ready mixed concrete producer and his customer.

A complete specification for concrete should cover the responsibilities of both parties—the manufacturer and the user. First, there is the selection of the quality of the concrete. That is solely the responsibility of the user except as he may be limited by applicable codes or other general requirements. Of course, the concrete producer is, or should be, a good adviser, but in the last analysis, the buyer must describe the concrete he wants.

The production and delivery of concrete to meet the description of the buyer is, with certain unfortunate reservations, the responsibility of the producer of concrete. That is to say, the producer must fill the prescription—however it may have been arrived at. He must mix the ingredients adequately and he must deliver the concrete with strict attention to good practices.

And then the buyer comes back into the picture. He must receive and place the concrete with due attention to limitations on time and handling so that the potential quality of the concrete will be preserved. The buyer is responsible for placing the concrete so as to minimize segregation and maintain homogeneity and for the protection of the concrete from extremes of temperature, either high or low, and from the drying action of the sun and wind. The best of concrete can be seriously damaged by improper handling. Less than good concrete can be made to do a respectably good job by skillful handling and adequate protection.

types of specifications

There are various approaches to describing the kind of concrete that is wanted, but all of them fall in one of two broad categories or some combination of the two. There is the prescription type of specification. The purchaser specifies the ingredients, the proportions, and the consistency of the concrete. The concrete producer is required only to fill the prescription.

Then there is the performance type. The purchaser specifies the strength and other necessary characteristics such as consistency, maximum size of aggregate, etc. The concrete producer has a relatively free hand and a heavy responsibility in selecting materials and proportions to meet these requirements. And, as already said, there is a third approach in which the demonstrated performance is demanded and, at the same time, limitations on the prescription are imposed.

There has been a strong trend toward the performance type of specification, with guaranteed strength being the principal limitation. The buyer has said that he is interested only in performance. He feels that he should not be required to bother himself with the responsibility of selecting materials and determining proportions to assure that the concrete will do what it is supposed to do. He feels, with much logic, that the ready mixed concrete producer is a concrete specialist and should know more about such things than himself—and that the ready mixed concrete producer should accept the responsibility. Under suitable specifications, judiciously administered, the responsible producer is willing to do so. But, at this time, suitable specifications which take into account all of the inherent variables are extremely rare.

examination of specific types

Strength specifications are a source of much uncertainty in estimating costs. The amount of cement required can be underestimated with complete honesty, with that underestimate supported by laboratory tests. Necessary

[1] Presented before Ohio Valley Chapter of the Construction Specifications Institute, Cincinnati, Ohio, April 8, 1959.
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FILE: Specifications

tolerances in strength test results, to take into account the inevitable variations, are more often than not underestimated because of a lack of general understanding of their magnitude and of what causes them.

A guaranteed strength specification presents many serious problems of administration and of assessment of penalties. The returns are not in until the structure is built!

And there is still another problem of strength specifications. They can be a cause for destructive competition based on differences in prices resulting from differences in quality—and that hurts the buyer as much or more than it does the industry. Unfortunately, all ready mixed concrete producers are not, by any stretch of the imagination, concrete specialists. Yet, in the average case, they compete price-wise with the producer who is a specialist. As competition becomes more keen, corners are cut. Pencils are sharpened too sharp! And there is always some wishful thinking as to strength levels and strength variations.

A prescription type of specification is most protective of everyone concerned, and it offers a better guarantee of strength than the guaranteed strength. The prescription should be based on properly controlled laboratory tests which demonstrate that concrete of the required quality will be produced. These tests should reflect minimum strength-producing properties of available cement, minimum qualities of aggregates meeting specifications, and maximum slumps of concrete which are permissive. They should not reflect results of special tests made with better than average materials and lower than average slumps. Then, filling the prescription should constitute conformance with the specification, assuming compliance with basic requirements as to mixing, elapsed time, etc.

In a legalistic sense, the purchaser of prescription concrete can assure himself that the quantities have been batched only by having his representative supervise the batching. Legalistic or not, that is not realistic, convenient, or economically practical in a great majority of the cases. The alternative, and a desirable and feasible one, is for the user to deal only with responsible ready mixed concrete producers and to accept their statements (or certifications) that proper quantities have been batched. That is the way it is done in a very large majority of the cases, with there being no check on the quality of the concrete except that based on the integrity of the producer.

Nevertheless, strength tests frequently are made for the prescription type of specification. It is entirely proper that there should be such a check on the continuing adequacy of the prescription. So, in a very large measure, the prescription specification takes on many of the aspects of the guaranteed-strength specification without the attendant evils and difficulties of administration. No reputable producer will fear that his concrete will not produce reasonably-to-be-expected strengths—if the sampling and testing are done correctly.

factors affecting strength test results

Strength test results for concrete are affected by numerous factors which, roughly, fall in three classes: (1) those which reflect the quality of the concrete; (2) those which are completely independent of the quality of the concrete; and (3) those related to normal variations in materials and testing procedures.

To attempt a thorough discussion of all of the factors in these various classifications would become too involved, but some illustrations may be helpful. If strength is to be used as a measure of the quality of the concrete as it is delivered to the user—that is to say as a measure of the quality of materials, correctness of selected proportions, accuracy of batching, and adequacy of mixing—tests must be made with meticulous adherence to standard procedures.

These standard conditions are clearly spelled out in accepted standards. They require that all operations be done "by the numbers" and that presents problems of man-power, know-how, and expense. Among other things, it requires that test specimens be held in controlled temperatures from the beginning and, after 24 hours, in controlled moisture conditions as well.

Sampling and testing to determine conformity with strength specifications are not casual operations. They require know-how and skill. Testing costs money and should be done by the user's agent and at the user's expense. Strength tests are performed in the midst of many influences difficult of control. Further, a large part, if not the largest part of the variations in strength results is due to such influences rather than to variations in the concrete itself.

When the concrete is sampled, the temperature and other weather conditions are whatever they are and not what they were yesterday or last week. That has an influence even if all sampling and testing are done meticulously. The sample may constitute as little as 1 cubic foot for a 6-cubic yard batch, which is certainly not unusual. That represents one part in 162—0.6 or 1 percent. Certainly it is difficult to avoid some error in sampling under the best of conditions—and the best of conditions are almost never obtained. Concrete test specimens are sensitive to temperatures to which they are exposed during the first 24 hours before they are scheduled to be cured under standard conditions—a schedule which too frequently is not followed. Then, there is handling and curing in the laboratory, capping, and testing!

A specification based on strength, implied or otherwise, which does not provide for the practical certainty that there will be a reasonable number of defective test results is economic dynamite. An understanding by both the producer and the user of the facts which may lead to low strengths, as well as some knowledge of the normal frequency with which low strength may be expected, is absolutely essential to any proper interpretation of strength limitations.

control of mixing water

Certain unfortunate reservations must be made to the production and delivery of the concrete being completely the responsibility of the producer. These have to do with the control of the quantity of the mixing water. It is that factor which has most to do with the uniformity of the concrete, or lack thereof, as it is delivered to the job.

Variations in grading and moisture content of the aggregates affect the amount of mixing water—and that control is strictly the responsibility of the producer. Variable times and speeds of mixing affect mixing water demand and that, in general, should be within the jurisdiction of the producer. However, delays at the job affect mixing water demand and that is frequently the responsibility of the customer.

Demands for additional mixing

water to produce a consistency wetter than specified are strictly the responsibility of the consumer. The too speedy introduction of additional mixing water, even when needed, is a common source of trouble when the truck driver is unduly influenced by the impatience of the customer. Water cannot be added in less than 3 to 6 minutes—and that seems a long time when one is waiting, especially with that wait accompanied by a considerable pay roll.

Other conditions, largely outside ready control, affect mixing water demand. These are principally tied up with temperatures—of materials, air and equipment.

effects of materials

Variations in characteristics of materials enter into the picture. Assuming aggregates of acceptable basic quality, the effect of variations in them on concrete strength is not likely to be important—if their grading is maintained within conventional limitations and if they are accurately proportioned. Unacceptable variations in grading, even within specification limits, are more likely to evidence themselves in differences in workability, placeability, and finishing rather than in strength. Variations in grading also will be reflected by variations in mixing water requirements, generally with corresponding changes in strength. The control of grading is important and it is feasible. "Long" gradings of coarse aggregate (a spread of greater than about No. 4 to 1 inch is long) should be batched in more than one size.

While on the subject of aggregates, reference should be made to some recent findings. Comprehensive tests contradict the long-accepted concept that concrete strength is benefited by using the largest maximum size of aggregate practicable. We tested aggregates having maximum sizes of ⅜, ¾, 1½, and 2½ inches. We found, in spite of normal reductions in mixing water requirements, that increasing maximum size of coarse aggregate above about ¾ inch did not improve either flexural or compressive strength. Considering all of the data, highest strengths were secured with a maximum size of ¾ inch; slightly lower or about equal strengths with the 1½ and ⅜-inch sizes; and lowest strengths with the 2½ inch maximum size. The results of these tests are reported in a paper presented before the Highway Research Board in January of this year.[3]

Cement is a variable. It is well known and a generally accepted fact that the strength-producing properties of cements from different mills vary widely. That different lots from the same mill also vary significantly is not so well known.

It should be pointed out that the variations are all, with negligible exceptions, well above specification limits. In spite of them the cement producer furnishes cement of at least the strength specified — and almost always substantially higher. Also, it should be emphasized that these differences in strength—whether from mill-to-mill or lot-to-lot—probably do not reflect proportionate differences in potential or intrinsic quality. In fact, such proportionality as exists could be inverse.

During the past three years we carried out an investigation of Type I cements shipped to ready mixed concrete plants from five different mills, widely separated geographically. These tests, published as an ASTM paper,[4] demonstrated:

(a) *As we expected, wide differences from source to source.*

(b) *Significant differences among shipments from the same mill with two of the five mills showing much better uniformity than the other three.*

(c) *An excellent correlation between compressive strengths of standard mortars and the strength of concrete cured under laboratory conditions.*

(d) *A reasonably good relationship between strength-producing properties and C_3S, suggesting that some limitations on the uniformity of compound composition might be helpful. That is for the future and not for now, but it is coming.*

what is the answer?

What is the answer? Certainly you do not want a vaguely drawn prescription specification calling for mixtures of 1:3:5, 1:2:4, 1:1½:3, etc. Certainly you do want to have assurances that adequate strength for the structure will be available. But, you should not want a simple statement of required strength, leaving to the judgment of the supplier or his agent the selection of proportions which will develop it and depending upon the uncertainties of tests of field samples to determine compliance.

Reference was made earlier to a prescription specification based on properly controlled laboratory tests. That statement should be amplified lest it be misinterpreted. There should be no need to have a different prescription for each job or each producer based on a multiplicity of groups of tests and combinations of materials. In the general case, and leaving out of account large and special projects with elaborate control facilities, there is probably not enough difference in materials and ability of different producers to perform to justify any such fine distinction.

Therefore, it seems desirable to establish classes of concrete based on minimum cement factor, maximum water ratio, range in slump, maximum size of aggregate, range in aggregate proportions, etc., which have been shown to produce the required strengths under approximately minimum conditions. Then see to it that these limitations are adhered to! It would be good economy to secure better than these specified results under the more favorable conditions that would frequently occur. And this should be regarded only as a desirable bonus. Strength tests should be made as frequently as necessary to check on compliance with these minimum requirements and the results should be interpreted in the light of a knowledge of variations reasonably to be expected.

What variations in strength are reasonably to be expected? That depends, but a tolerance of something of the order of 15 percent of the tests falling below 90 percent of the average would represent reasonably good performance. There should also be a tolerance at a lower level—say, 1 or 2 or 3 percent below 80 percent of the average. Tolerances should be realistic. Under the best of circumstances, field tests made 28 days after the work is in place represent an unsatisfactory basis for determination of compliance.

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[3] "Relationships of Concrete Strength to Maximum Size of Aggregate," by Stanton Walker, Delmar L. Bloem, and Richard D. Gaynor, presented before 38th Annual Meeting of Highway Research Board, January, 1959. See also National Sand and Gravel Association Circular No. 74, "Effect of Maximum Size of Coarse Aggregate on Strength of Concrete," by Delmar L. Bloem.

[4] "Variations in Portland Cement" by Stanton Walker and Delmar L. Bloem, ASTM Proceedings, Vol. 58 (1958), reprinted as Publication No. 76 of the National Ready Mixed Concrete Association.

conclusion

The problem of concrete specifications and their administration can be examined from a number of different points of view, and there are a number of miscellaneous, but not always related, factors which merit consideration.

We have said much about strength, as reflected by strength tests, primarily from the point of view of errors inherent in them. But leaving out of account the problems presented by these inherent variations, let us look a little more closely at the significance of strength values.

First of all, strength as measured by standard tests is a transitory thing. It is the measured strength of the standard specimen at the time the test is made. It is not the ultimate strength! It may, among other things, reflect considerable differences in 28-day-strength-producing properties of cement which largely disappear at later ages. It does not reflect, in anything approaching a quantitative fashion, the load-carrying capacity of reinforced concrete members. The compressive strength of concrete determined by a 6- by 12-inch cylinder affords only a relative measure of ability to resist stresses in a beam or spiral column. Further, the same concrete in test specimens of different dimensions gives different unit strengths. So, after all, measured strength is only relative to the ability of concrete to resist stresses.

Also, strength is not a sufficient measure of the overall ability of concrete to perform. For example, strength is no criterion of the ability of concrete to resist the aggresive action of weathering except to the extent that it affords a general measure of quality—of sufficient cement, low enough water ratio, etc. What we want is good concrete, and strength alone is an inadequate and over-simplified measure of ultimate quality.

But, we do want to make strength tests as a guide in the selection of proportions and as a check on adherence to them. We have already pointed to the importance of exercising care in testing. We should supplement what has been said by emphasizing that the know-how for exercising the required care is clearly spelled out in nationally and internationally accepted standards of the American Society for Testing Materials. These standard test methods are based on a knowledge of the difficulties of securing accurate results and, accordingly, are drawn in such a manner as to require meticulous care in their conduct—which presents a temptation to short-cut them. That temptation should be resisted.

There are many other factors which might be discussed and which are pertinent to this subject. The subject of admixtures is one. They represent a valuable addition to concrete technology but none of them is a cure-all. In particular, admixtures which are represented as being cement stretchers should be examined most carefully. Water-reducing retarding agents have only recently come to the forefront. They deserve study. Intelligently used, they have a considerable potential for good. Unintelligently used, they can cause a lot of trouble. The whole subject of hot and cold weather concreting presents a worthwhile subject for discussion and your attention is directed to two recommended practices of the American Concrete Institute, one covering cold weather concreting[5] and another covering hot weather concreting.[6]

Something should be said about flexural strength. It is being used to an increasing extent as a basis for specifying concrete quality and determining its acceptability in concrete pavement construction, airport runways, and similar structures. Pavement designs almost invariably are based on flexural strength. In recent years there has been a trend toward depending on tests of beams molded in the field as a basis for acceptance of the concrete. This has produced some new problems.

Flexural strength specimens are influenced differently from compressive strength specimens by variations in test procedures. Most important is the distribution of moisture within the specimen. If, during the curing period, the outer shell of the concrete test specimen is allowed to dry in relation to the interior, the shell shrinks and tensile stresses are developed. In the case of compression tests, everything else being equal, such "pre-tensioning" causes an increase in measured strength. For the beam, on the other hand, the result is a decrease in strength—up to about 30 to 35 percent. For these and other reasons, there should be grave doubt as to the applicability of field molded concrete beams as a basis for acceptance. END

[5] "Recommended Practice for Winter Concreting" (ACI 604-56).
[6] Proposed "Recommended Practice for Hot Weather Concreting" (ACI Comm. 605).

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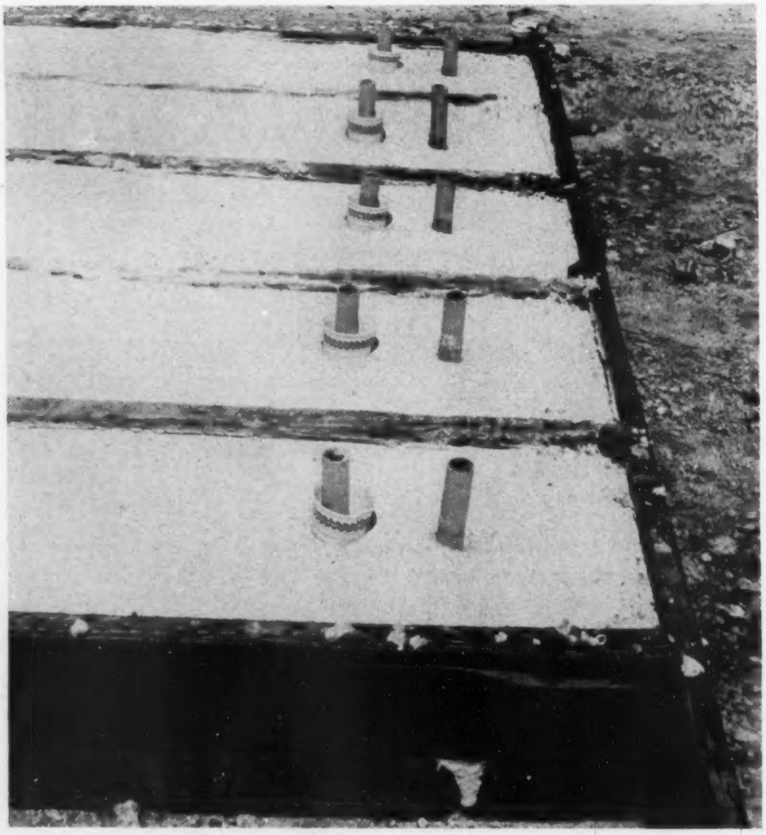
154 Distl Avenue, Mansfield, Ohio

Cost of this concrete seawall was cut from $40 to $16 per foot

when precasting work was shifted from a central yard to the job site.

ON-SITE PRECASTING



A DRAMATIC INSTANCE has come to our attention of the savings which can often be realized by precasting concrete elements on the job site with ready mixed concrete instead of manufacturing at a remote central yard and shipping to the point of use. The job in question involved the construction of 9½ miles of reinforced concrete seawall at Hallendale, Florida.

The project design called for the construction of nine curved islands girded by concrete seawalls consisting of interlocking piles and slabs. The lowest bid on the seawall work was $25 per lineal foot, so the contractor decided to handle this portion of the project himself. He accordingly set up a central yard and began casting piles and slabs in wooden forms. The resulting seawall was beautiful but the cost was a completely prohibitive $40 per lineal foot in place.

Careful analysis of the entire operation indicated that too much time was being expended handling and rehandling the components because of casting away from the job site. Much of

The piles were cast five at a time in multiple molds. Paper tubes provided holes for attaching the bolts which connected the piles to deadmen.

FILE: Precasting

Steel angle iron frames placed directly on ground were used for site precasting some 8,500 seawall slabs for Golden Isles Community at Hallendale, Florida. Note strip of paper placed on ground at one end to give smoother surface for taking forms for cast-in-place concrete caps. At other end are sloped blocks to form notches for slab. Finished slabs, with smooth troweled top sides, are visible at the right.

the high cost was also traced to the necessity of making frequent repairs to the wood forms, which had a tendency to break during stripping.

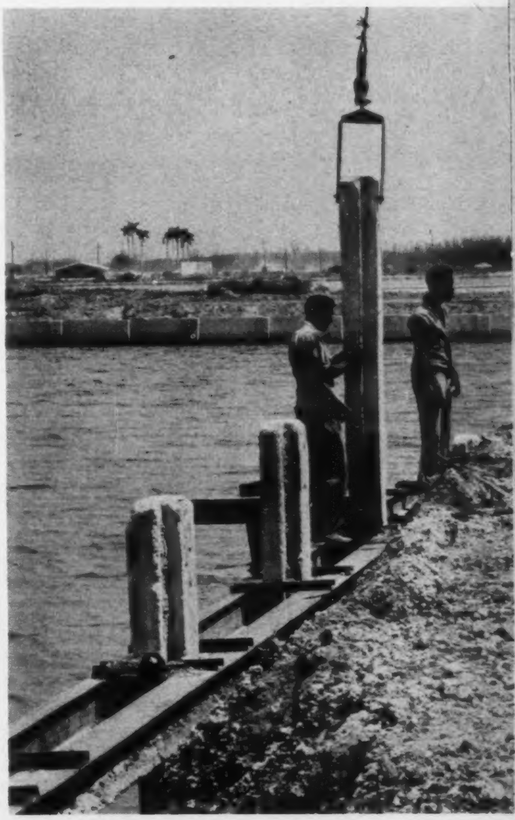
It was accordingly decided to cast both the slabs and the piles on the islands on which they would be used, and at the same time a decision was also reached to use steel forms in place of wood. Under this plan of operation even the concrete deadmen used to hold the piles vertical were cast where they were needed.

With the steel forms it was possible to obtain two uses per day. Piles were cast five at a time in multiple forms, and when production really got rolling the crews were turning out up to 50 slabs and 60 piles a day. Mass production methods were used throughout, each crew being trained to work as a unit, and each individual being encouraged to develop maximum skill and speed for whatever phase of the operation was assigned to him.

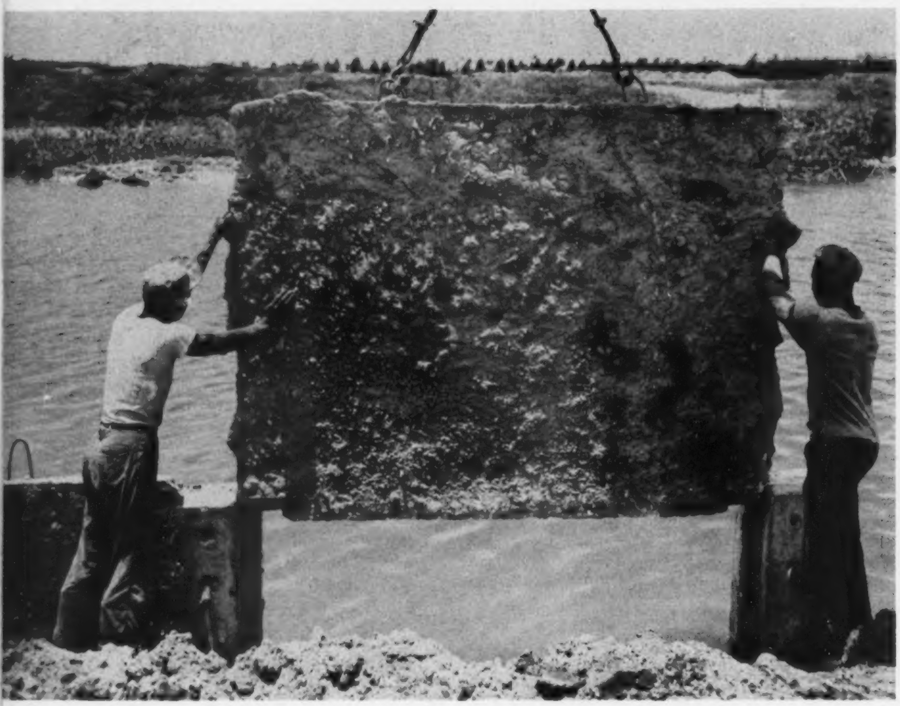
The top six feet of each piling is T-shaped, and the slabs fit between the webs of the T's on adjacent piles with the flanges holding them in position. Piling lengths ranged from 12 to 16 feet depending on the depth required at various locations. Notches at the bottoms of the slabs fit into matching sockets at the base of the T on the piles. The notches are sloped so that the weight of each slab forces it against the two supporting piles to form tight joints.

Each pile is held in a vertical position against earth pressure by a 2- by 2-foot by 4-inch thick concrete deadman to which it is connected by a 13-foot tie rod. Both the deadmen and the slabs were cast directly on the ground. In the case of the slabs the top sides were finished and allowed to face the waterway. So that forms for the cast-in-place caps would fit properly, a strip of paper was placed on the ground near the top of the slab in order to provide a somewhat smoother surface.

Installation of the seawall was simplified by designing a template made of two 54-foot steel beam sections



View of the steel beam template used for positioning the T-shaped concrete piles so that the slabs would fit snugly between adjacent units. Note how the notch is sloped at the base of the T-shaped topmost section of the end pile. The indent serves as a socket to take the matching notched slab.



Here one of the slabs is being lowered into position between the two piles which will support it. The weight of backfill holds the slabs firmly in place against the piles, which are themselves supported by bolts anchored to concrete deadmen. Note how the lower corners are notched so as to fit tightly against the matching sockets at the base of the T on the piles. The side of the slab facing the waterway is troweled smooth.

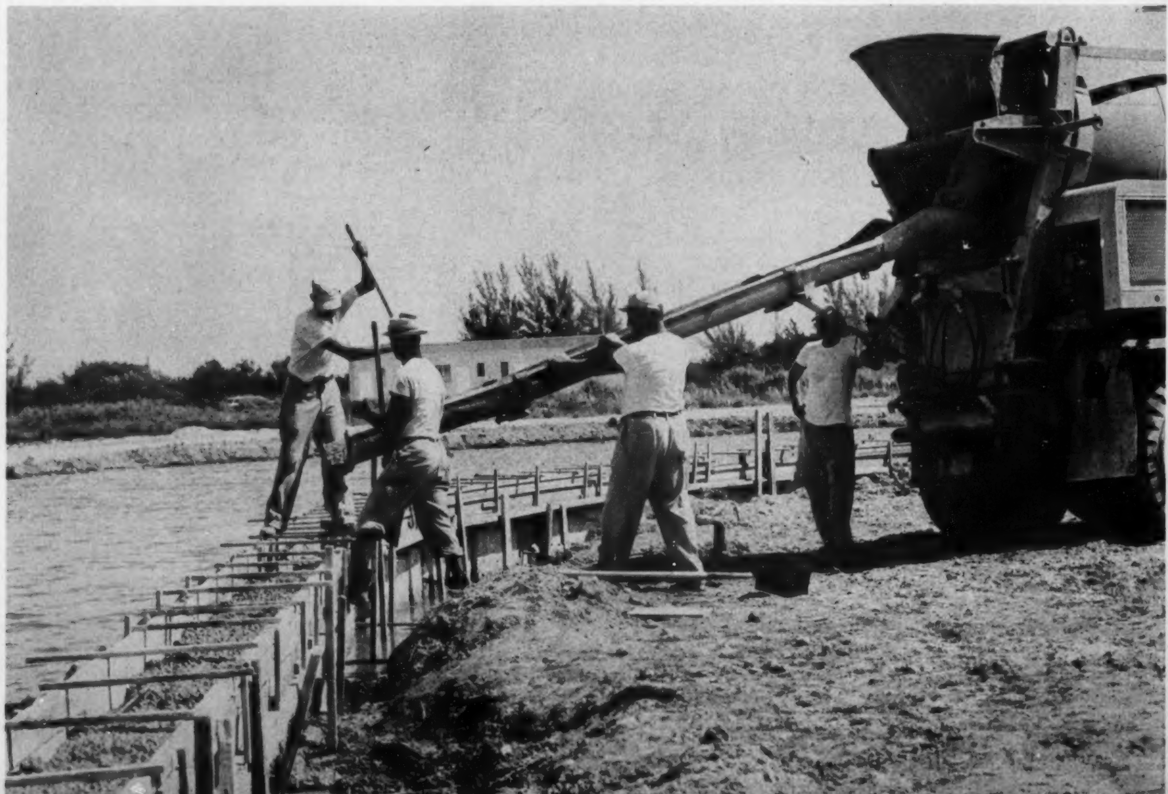
capable of accommodating six piles and five slabs. When the template was anchored into place at the shoreline, the pile driving crew needed only to slip each pile into a slot and drive it.

A backhoe was found to be a most efficient machine for installing the slabs. The backhoe operator made a cut for the 13-foot tie rod between the pile and the deadman, then backfilled the trench and finally picked up a slab by protruding loops of reinforcing steel cast into the top of each unit. Immediately behind the installing crews came the capping crews, the latter setting 18-inch wide by 6-inch high cap forms and 3/8-inch reinforcing rods.

With all of these economy and efficiency measures, the cost of the seawall installed was finally reduced to $16 per lineal foot. Much of the saving is attributed to the elimination of the frequent rehandling which proved to be unavoidable when the precasting was done at a central yard. As the crews gained skill and experience, output rose steadily to a peak of around 200 lineal feet of finished seawall per day.

The manufacture and installation of the seawall components was handled by Layne, Inc., developers of Golden Isles Community. Maule Industries supplied a total of 18,200 cubic yards of 3,000-psi ready mixed concrete for the 8,500 pilings and slabs and for the covering cap. END

Ready mixed concrete, which was also used for all the on-site precasting, is here being used for the cast-in-place cap with which the seawall was topped.



a concrete mushroom grows in sweden

ARCHITECTURAL MERIT was the dominating requirement for a new water tower completed recently at Orebro in Sweden. The tower has a central location in the town, amid middle-class homes, and one of the essential requirements was a slim profile which would give the least possible shade. Since the tower would also be a prominent landmark for the town, the local Water Board decided to go to additional expense for an unusual design. The tower capacity is almost 2½ million gallons and by conventional standards this would require a very bulky structure; by means of extensive prestressing it was possible to achieve the strikingly attractive structure shown in the accompanying pictures.

The supporting stem of the water tower has an outside diameter of 35 feet and is based on bedrock some 30 feet below ground. The conical reservoir (slope 1 : 1.5) has a maximum diameter of 146 feet, the depth of water contained is 44 feet and the highest water level is 164 feet above ground level. The three basement stories of the tower contain service rooms. Three elevators in separate shafts are provided up to a viewing deck and restaurant. The restaurant is roofed by a conical shell of normal reinforced concrete construction, 5 inches thick; its floor is supported by 32 precast pre-tensioned radial beams which rest on the stem wall and on columns set in the conical wall of the reservoir.

Although the design resulted in substantial savings in material costs, it presented some difficulties in respect to formwork. Form supports up to 132 feet high would have been necessary and because of the conical shape even a very slight deformation of the supports could create a tangential pull which would lead to cracking the concrete. To overcome these problems the contractors decided on an ingenious technique which involved casting the reservoir portion complete on the ground and lifting it up during the construction of the supporting stem. The restaurant, roof structure and internal staircases were all built during this lifting process.

In the first stage of construction the substructure was cast and some 60 feet of the elevator shaft housing was built using sliding forms. A 2-ton tower crane with a radius of 75 feet was then erected on top of the elevator housing to assist casting of the reservoir portion. This crane followed the tank walls up during lifting. Low-heat portland cement was used throughout to reduce the danger of cracking. A 3½-inch slump was specified for the concrete.

Freyssinet cables consisting of twelve

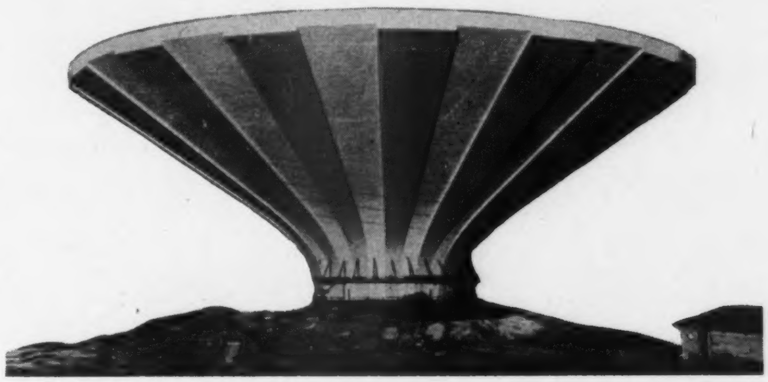
FILE: Reservoirs

0.275-inch diameter wires were used in the prestressing operation; 206 cables were necessary, the longest of which measured 250 feet. Each cable encircles half the circumference of the tank. The cable force averaged 37 tons after deductions for all losses. After prestressing the cable ducts were pressure grouted with neat cement grout; air outlets were not provided during grouting as it was thought that the possibility of subsequent water leaks at these points could not be risked. Before lifting of the reservoir began, the concrete was carefully checked for freedom from cracks and water-tightness and finally given two coats of cement paint in contrasting white and gray shades.

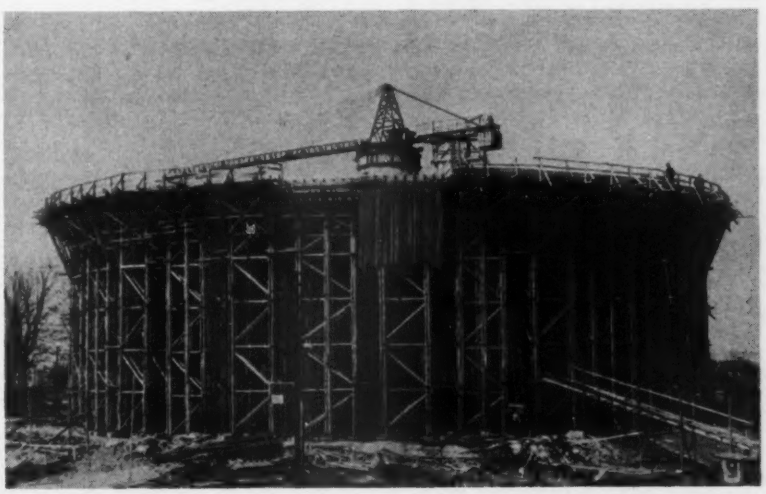
The total weight of the structure involved in the lifting operation was 3,200 tons. Lifting was done by means of 32 hydraulic jacks fixed upside down around the lower edge of the reservoir portion. The stem walls have a thickness of 30 inches. Each jack was proof-loaded to 200 tons before the work began. Twenty-nine of the jacks were connected to a motor-driven pump (with a pump of equal capacity in reserve), the other three being hand-operated at the third-points of the circumference. The method was to take the bulk of the load on the 29 jacks and to use the three hand-operated jacks as governors to insure perfectly vertical lifting. Provision was also made for three of the motor-driven jacks to be hand-operated in the event eccentricity of loading might be encountered as a result of severe wind pressure or non-uniform placing of the concrete.

Each jack had a stroke of 6 inches. The lifting was done in stages by jacking to a height of 5 inches and then inserting a 4-inch high aluminum disc between the jack and the concrete below. After three of these 4-inch lifts the discs were removed and replaced by precast concrete cylinders 11½ inches high. Some 4,000 of these high-strength precast cylinders were used for the construction; each cylinder was tested under a load of 350 tons before use. Another 4-inch lift was then made so that concrete for the 30-inch walls could be placed between sliding forms to encase the precast cylinders. It was possible to place concrete to a height of two cylinders per working day; the lifting operation took just over three months. END

Pictured below is the reservoir at the beginning of the lifting operation. The above photo shows an intermediate stage during the lifting. The hydraulic jacks and fresh concrete have been enclosed within a tar paper shelter for protection from the weather.



Construction of the reservoir portion on the ground, showing the tower crane mounted on top of part of the elevator housing. The prestressing cables were assembled in a nearby shack and hauled up the ramp into the forms over rollers.



RECENT EXPERIENCE WITH THE POWDER LANCE

AN IMPROVED POWDER LANCE* is opening up possibilities for still greater use of concrete—especially among missiles makers and operators of industrial plants who need no longer hesitate to install temporary concrete structures for fear of a precarious and costly removal job later. Burning a mixture of aluminum and iron powder in contact with pure oxygen, the lance literally melts away concrete with a very high-temperature (6,000 degrees F.), high-velocity flame.

Extensive field tests have indicated that there is almost no limit to thickness of the concrete that can be pierced. For example, it was necessary to slice up 8,000 cubic feet of a turbine-testing pit the General Electric Company wished to move in order to add the space to an existing $1,000,000 building which had to continue operations during demolition.

The hexagonally-shaped pit consisted of two reinforced concrete safety walls 16 feet high, separated by 6 feet of packed sand. The inner wall was 3 feet thick; the outer wall 4 feet.

Six massive sections measuring 16 by 20 feet and weighing up to 96 tons each were cut out of the wall by the quiet torch, and a hole pierced in each section for a hoist chain. A 100-ton overhead bridge crane lifted the sections from the pit and onto trucks for removal. The demolition contractor estimated the removal cost of the concrete at 40 percent below the cost of any other method, because cutting speed proceeded at the rate of 18 inches an hour.

Similarly, at a DuPont plant in Belle, West Virginia, powder-lancing sliced through a 4- by 5-foot, 38-ton concrete slab in 3½ hours. Previous attempts had been made to cut this heavy section with pneumatic drills. It was estimated the drilling crew would have required 5 days to complete the cut.

In a Pittsburgh steel mill, 725 tons of concrete was powder lanced from a furnace foundation in 80 hours lancing time. Nine cuts were made to

*First reported on in the March 1957 issue of Concrete Construction, page 7.

The lance at work . . .

FILE: Cutting Methods

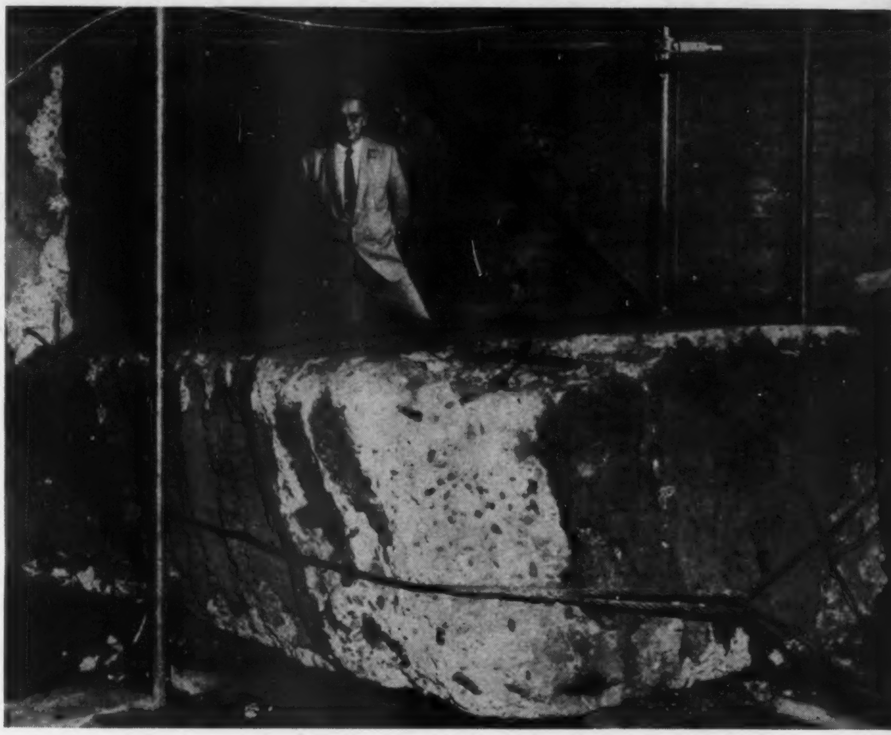
produce 5 massive concrete sections. The mill estimated that powder lancing saved $6,000 in labor costs on the job.

Revising the ash removal systems of several steam generators in a Kentucky plant made it necessary to remove reinforced concrete boiler pads measuring 3 feet by 4 feet by 18 feet. These had to be severed without halting the power output of the generators.

A series of 14-inch cuts were made in the bottom of each boiler pad with the powder lance. Then a top cut 10 inches deep and running the entire 18-foot length of the pad was made to weaken it. The weakened pad was finally broken away from the boiler with a 50-ton hydraulic jack. Total lancing time was only 14 hours.

Thus a simple alliance between oxygen and metallic powders under the driving impetus of nitrogen propelled through an iron pipe, is making it increasingly practical to use concrete even for relatively temporary installations, where the material's permanence and tremendous staying power might formerly have been counted as disadvantages. END

And a view of what it does.



THE CONCRETE INDUSTRY BOARD OF NEW YORK CITY . . .

its Purposes, Methods and Accomplishments

By VICE ADMIRAL JOHN J. MANNING*

A FEW YEARS AGO one of the public agencies of the City of New York indicated that consideration was being given to restricting the use of concrete for structural frames of multi-story buildings, because of the lack of uniformity in the quality of concrete. The result of such an edict would have been a serious blow to the concrete industry in the Metropolitan New York area, and a group of prominent members of the industry took the matter under consideration.

There exists in New York an organization known as the Building Trades Employers' Association, organized primarily for handling wage negotiations, union relationships, job conditions, fringe benefits, etc. One important adjunct of the B. T. E. A. is known as The Cement League, whose membership includes a majority of the concrete contractors in the area. A group of its members, sponsored by The Cement League, was organized for the purpose of correcting the conditions complained of by the public agencies, and it was from this nucleus that The Concrete Industry Board came into being.

It was felt that the C. I. B. should reflect to a considerable degree the construction phase of the concrete industry. There were no complaints about the theory and design of structural concrete, it being the consensus of opinion that the research institutions, the American Concrete Institute, and the American Society of Civil Engineers were providing adequate technical skill in the preparation of designs and specifications.

It was considered that the function of The Concrete Industry Board would be to see that the requirements of the design were properly carried out as regards selection of the ingredients, the mixing of the basic concrete, care and handling in its production, placing in the forms and adequate curing.

In the past whenever difficulties arose somewhere along the line in the construction of a concrete structure, it had been practically impossible to place the responsibility where it belonged. The ready mix man blamed the testing laboratory, the laboratory blamed the contractor, the contractor blamed the design, so that one went round in a complete circle, with no stopping point.

It was self evident that the concrete industry needed complete coordination—the same coordination which has proved to be essential in the production of every other type of construction material. To obtain this coordination, the Concrete Industry Board of New York invited to membership representatives of every component of the industry. The aims and objectives of the Board were the continued production in completed structures of concrete of uniform quality, of the type and strength specified for the structure.

To assure that the group would be truly representative of the industry, each component was represented on the board of directors. As a further safeguard, it was decided that the representative of a particular group on the board of directors would not be determined by internal vote in the C. I. B. but would be nominated by the group which he represented. For example, the Metropolitan Section of the American Society of Civil Engineers nominates its representative on the board of directors, as do the New York Association of Consulting Engineers, the American Concrete Institute and the American Institute of Architects. Similarly, representatives of the testing laboratories, the ready mix producers and others are named by their respective groups.

Obviously a board so constituted cannot be accused of favoring a particular group within the industry. It is a board truly representative of the concrete industry, whose objective can be only the improvement and strengthening of the industry as a whole.

The Board is presided over by of-

*Admiral Manning, now managing director of The Concrete Industry Board of New York City, was formerly Chief of the Bureau of Yards and Docks and Chief of the Corps of Civil Engineers, U. S. Navy. This article is based on a paper presented at the annual convention of the National Ready Mixed Concrete Association last February.

FILE: Associations

ficers elected by vote of the membership, consisting of a president, a vice president, a treasurer and a secretary. The constitution provides that: "While it is not mandatory the Nominating Committee shall recognize that it is the preferred policy of the Concrete Industry Board that the President shall be a member in good standing of The Cement League." Inasmuch as the membership of the Cement League is composed entirely of concrete contractors (general and sub-contractors), it follows that the office of president is usually filled by a concrete contractor.

The C. I. B. is unique in that it gives the contractor recognized status vis-a-vis the architect, engineer and other technical groups. Such recognition must in itself develop an increased degree of responsibility on the part of the contractor, his subcontractors and their personnel.

Original organizational plans were developed and met with spontaneous and enthusiastic approval. The organization obviously had to be self-contained and self-sustaining. Contributions from major parties interested provided the original funds for setting up the Board and the members were assessed a nominal amount for dues.

It was recognized that the principal means of accomplishing the purpose of The Concrete Industry Board were through interchange of knowledge and by education. The Board has no enforcement authority of any kind. It simply provides a forum wherein the members can freely discuss problems with their contemporaries and members of other branches of the Industry.

The Board holds monthly luncheons at which engineers sit down with contractors, subcontractors with architects, testing laboratory men with ready mix men, and all can freely exchange ideas and experiences. There are ten such meetings each year. For each a prominent speaker is on hand to discuss some subject of general interest to the members. One meeting takes the form of a field trip to study prominent concrete structures under construction.

At the present time the Board has a membership of 237, consisting of 107 company memberships and 130 individuals. It issues a monthly report which includes an announcement of the coming meeting and a discussion of the Board's activities. Income from dues at the present time is not sufficient to meet operating expenses, so the Board is still dependent on contributions.

As is customary in an organization of this type, all operations are carried on by and through committees. The following committees are now active: advisory committee; building code committee; committee on concrete finishes; grievance committee; committee on procedure for hot or cold weather concreting; program committee; ready mix committee; and testing laboratory committee. There is no technical staff and the paid employees are limited to the managing director and his secretary.

In general an effort is made to keep committees small, since the Board believes that small committees are more effective than large ones. However, when a committee has under consideration a matter of industry-wide interest, an effort is made to include representatives of every major group.

Prior to the organization of the Board there was neither cooperation

(continued on page 20)

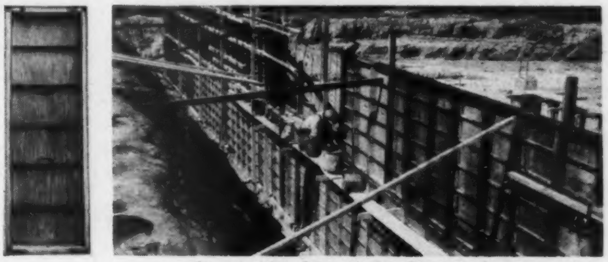
SYMONS FORMS can help your firm

save on labor and material costs . . . save time . . . do a better job

Symons different type forms are not confined to a single type of application. They can be used on most any type construction job and on any height wall. Factory-made from the finest of materials. Frames of the Steel-Ply and Mag-Ply Forms have an indefinite life.

Wood-Ply

Symons manufactures three types of wood forms. *High Strength Panels* . . . recommended for pouring concrete walls with pressures up to 1,200 pounds per square foot; *"Champ"* Panels . . . for both commercial and residential work; *Light Construction Panels* . . . for light or residential construction, where heavy pressure is not a factor.



Symons High Strength Panel has steel cross members on 12" centers. Its weight averages just 5 pounds per square foot.

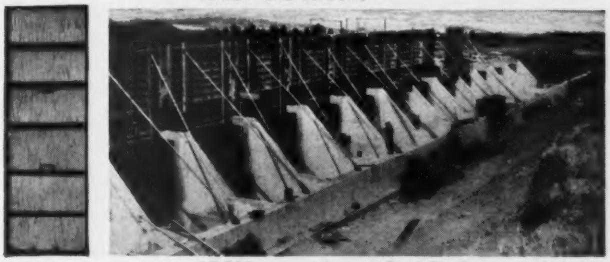
Wide Panel

Symons Wide Panel Forms have steel struts and 2x4 cross members to strengthen the panel and minimize deflection when subjected to heavy pressure. These forms are used in gang forming. They have tie holes in the steel struts which allow the insertion and removal of special ties when the panels are ganged. Built in 6' and 8' lengths and 30", 36", 42" and 48" widths.

Pouring a 2,400 foot retaining wall with Symons Wide Panel Forms made up in gang sections of 10'x24' and 15'x24'.

Steel-Ply

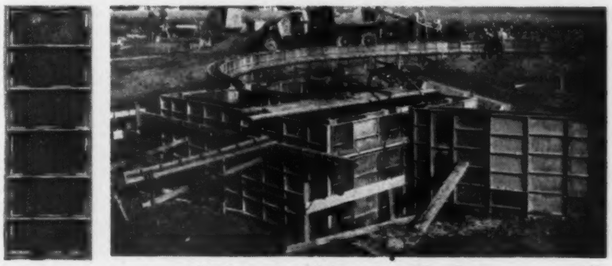
Designed for durability and long-life. The initial cost of these forms is higher than Symons Wood-Ply Forms. However, this first cost is more than offset by the many reuses possible with these panels. They are easily erected and stripped with the 3 basic pieces of the Symons System—connecting bolt, panel tie and wedge.



37,000 square feet of Steel-Ply Forms used on the Air Force Academy, Colorado Springs, Colorado.

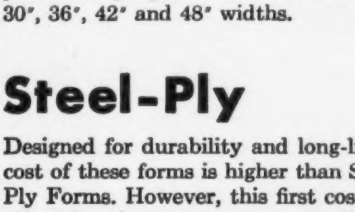
Mag-Ply

Symons Mag-Ply Forms are the lightest forms available . . . weight averages about 3½ pounds per square foot. The frames of durable, rust-proof magnesium completely encase the plywood, will last indefinitely and will not swell or shrink. 2½" thickness of frames means more panels per truck load, less space for stacking and storage.



Light and efficient Mag-Ply Forms are readily adaptable for circular, battered and cut-up walls.

Only 3 Hardware Pieces



Symons Forms available on a Rental Basis.
Rentals can apply to purchase price.

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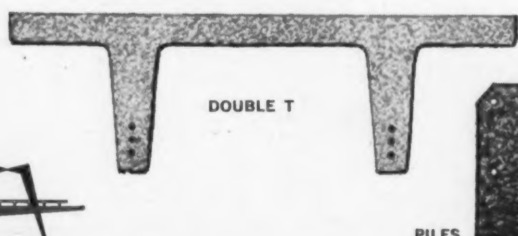
NOW! A NEW SOURCE FOR PRESTRESSED CONCRETE STRAND

Quality materials, modern equipment and the expert craftmanship of an experienced major steel company—JONES & LAUGHLIN—guarantee a prestressing strand that will satisfy your most rigid requirements. All orders and inquiries given prompt attention. Write or call your nearest J&L District Sales Office now!

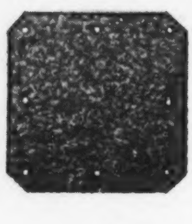
PHYSICAL PROPERTIES AND LOAD TABLE

Strand Diam. (In.)	Wt. Per 1000' (Lbs.)	Approx. Area (Sq. In.)	Minimum Breaking Strength (Lbs.)	Loads at Following Percentages of Minimum Breaking Strength (Lbs.)		
				60%	70%	80%
¼	122	.0356	9,000	5,400	6,300	7,200
5/16	198	.0578	14,500	8,700	10,150	11,600
⅜	274	.0799	20,000	12,000	14,000	16,000
7/16	373	.1089	27,000	16,200	18,900	21,600
½	494	.1438	36,000	21,600	25,200	28,800

Approximate Modulus of Elasticity: 27,000,000 psi.



DOUBLE T



PILES

PILES

Member
Prestressed Concrete Institute

"STRENGTH THROUGH STRESS"

nor coordination between the various testing laboratories operating in the Metropolitan New York area. They were a group of completely independent competitive units, acting independently without standards of any kind as regards uniformity of service. The C. I. B. was the medium which brought this group together. This important group has been having regular meetings for the past two and a half to three years, and among its accomplishments is the preparation of a *Manual of Recommended Practice for Inspection and Testing of Concrete Materials and Concrete* which has served to standardize the services of all the laboratories in the area. The Manual has been exceedingly well received, and there have been requests for copies from such widely dispersed parts of the world as Australia, India, Israel, and England.

One of the greatest sources of controversy in the field of concrete construction is the matter of finishes. A specification will require that concrete be finished to a "smooth surface of uniform texture," and your trouble starts right there. What is smooth in one man's opinion might be raspy as a file to another, and the matter of texture depends upon whether you look at it full face or obliquely.

In the early days of the C. I. B. a committee was organized for the purpose of writing a specification which would rid us of this ever-present trouble maker. This committee struggled with the problem for some time, and ultimately gave up the ghost.

A second attempt, however, resulted in the publication of a *Manual of Recommended Practice for Cast in place Exposed Architectural Concrete Finishes.* This manual is written in the form of a specification, and for each paragraph of the specification there is a corresponding paragraph entitled "Comments" which sets forth the basis for the specification requirement.

The preface of the manual has this to say:

> *An exhaustive investigation by a Selected Committee of the C. I. B. has produced this manual. It is offered to assist the architect and engineer whose specifications are intended to produce satisfactory exposed architectural concrete surfaces.*
>
> *It is recognized that the placing of covering veneers on concrete surfaces adds very materially to the cost of concrete structures without in any way improving their structural soundness. It is felt that proper treatment of concrete surfaces can produce a satisfactory finish, both in texture and appearance, on the concrete itself, thereby eliminating these additional costs.*
>
> *The durability and appearance of properly developed exposed concrete surfaces are attested by many existing structures in all geographical locations.*
>
> *It must be recognized that surface development does represent an additional item of cost and is justified only on surfaces exposed to public view. This, however, in no way compares with the cost of a veneer coating of any other material.*
>
> *Recognizing that a special effort is necessary to develop satisfactory exposed concrete surfaces, the Manual is explicit as regards detailed procedures to bring about the desired results.*
>
> *The manual contemplates complete coordination of the exposed finish design within practical construction limitations. Detailed methods are outlined to fully inform prospective users of the special procedures that are involved and are considered essential in producing these results. It is hoped it will clarify the subject of concrete surfaces; will eliminate ever-recurring arguments about such phrases as smooth surface . . . lack of blemishes . . . elimination of fins, honeycomb, etc.*

The work of this committee has been so successful that its activities have been extended to write a specification for concrete floors, fills and finishes. Considerable difficulty has frequently been experienced with lightweight concrete fills on structural slabs, which are usually included in the floor to provide runways for duct systems. Inasmuch as this fill contributes noth-

(continued on page 22)

ALPHA

BETTER CONSTRUCTION THROUGH BETTER USE OF CEMENTS

news and notes from the field

Overcoming the Problems of Hot Weather Concreting

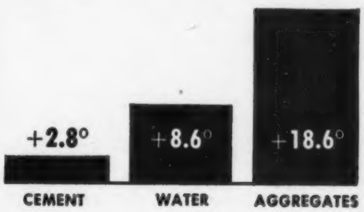
Hot weather can be made to work *for* you in concreting—if certain precautions are observed during placing. The dangers of inadequate preparation before placing, high MIX temperatures and poor curing protection should be understood and controlled.

Effects of High Temperatures

High temperature accelerates the setting time of concrete and promotes rapid evaporation of moisture. The setting time is based on mix and curing temperatures of 73°F. As the temperature rises the setting time accelerates. When the temperature of the concrete is allowed to climb too high, there is danger of "quick set" and permanent strength damage.

What causes High Concrete Temperatures?

The temperature of fresh concrete is affected by the temperature of the materials and the mixing conditions. Take an average five bag mix and increase the temperature of each ingredient 30°. The graph below shows how much each affects the concrete temperature.



What Happens When Temperature of Fresh Concrete Runs Too High

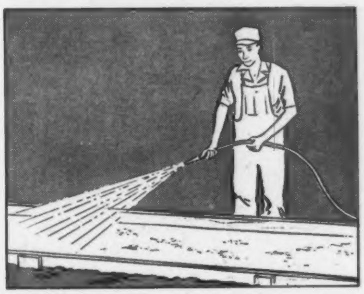
- Permanent strength reduction
- Early stiffening or quick set
- Increased water requirements
- Increased probability of cracking

More information on Hot Weather Concreting is available in Alpha's "Craftsmanship in Concrete" Folder #2. Free copies are available.

Ways of Reducing Mix Temperature:

1. Sprinkle hot aggregate stock piles with hose or fog spray.
2. Apply fog spray to aggregates or conveyor belts.
3. Use crushed ice in the mix replacing water—pound for pound.
4. Avoid stock-piling aggregates directly in the sun.
5. Protect mix-water storage and lines from direct sun.
6. Avoid the use of strength accelerators in hot weather.

Tips For Best Results

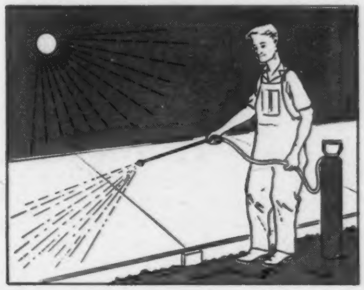


1. Subgrade should be damp (not muddy) so it will not absorb water from concrete.

2. Have adequate help available to handle concrete rapidly.

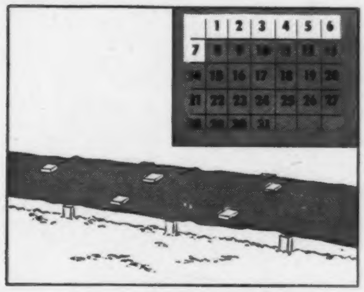
3. Discharge MIX as soon as possible after proper mixing.

4. In extremely hot weather it may be necessary to shade concrete or use wet coverings until final finishing can be completed.



5. In hot dry breeze erect wind break or use fog nozzles on upwind side of fresh concrete.

6. Start curing operations as soon as concrete has set enough to avoid surface damage.



7. Cure concrete for at least 7 days where durable wearing surface and strength are important.

8. Keep test cylinders shaded and damp until they are ready to be sent to laboratory after 24 hours.

ALPHA
PORTLAND CEMENT COMPANY
Alpha Building, Easton, Pa.

ing to the structural strength of the building, it is desirable to keep its weight to a minimum, and there begins the difficulty of trying to get a lightweight material to become an integral part of a dense structural slab and a hard surfaced floor finish.

The Board's committee on hot or cold weather concreting has issued in preliminary form its proposed *Recommended Practice for Cold Weather Concreting*. This was issued last fall and was of great value to the industry during this year's severe winter weather. On completion of the section covering hot weather concreting, it is planned to issue the complete *Manual of Recommended Practice for Concreting Operations During Hot or Cold Weather*.

Similarly the ready mix committee has completed the preliminary draft of a *Manual of Recommended Practice for Production, Delivery and Use of Ready Mixed Concrete*. This manual was prepared by a committee consisting of representatives of each of the major ready mix producers in the Metropolitan area, as well as general contractors, concrete sub-contractors and engineers.

Extensive work has been done toward revamping and recodifying the New York City Building Code. Anyone who has ever struggled with this code as it pertains to concrete, will readily recognize the necessity for a major overhaul. It is a herculean task-technically, editorially, and even more so, politically.

The grievance committee of the C. I. B. is available to any member for settling disputes, misunderstandings and differences of opinion. This committee has been extremely beneficial in extinguishing brush fires, so to speak, before they assumed serious proportions. The C. I. B. has indeed become sort of a clearing house for all matters pertaining to concrete, as is indicated by the number of inquiries that come to the office from the public in general in connection with problems that arise incident to the use of concrete.

The time has clearly come when the very life of the concrete industry is dependent upon complete coordination and the cooperation of all its members. This the Concrete Industry Board has accomplished in the Metropolitan New York area. It is a safe prediction that similar organizations will develop and flourish in other communities. END

The BBRV system being used with electrically-operated jacks to prestress a bridge deck.

NEW PRESTRESSING SYSTEM

A NEW SYSTEM OF PRESTRESSING known as the BBRV system is becoming increasingly popular in Europe. The system has been in use for the past few years in Switzerland, Austria, France, Germany and Italy and recently received its first large-scale application in England for a service bridge in Kent. The advantages claimed for the system lie in the simplicity of the anchorage and in the greater amount of force that can be applied per cable.

While most systems of prestressing depend for the efficiency of their anchorage on the friction developed by some form of wedge, the BBRV anchor uses a direct form of bearing by "nail-heading" the end of each wire of the cable. Such a nail-head has a strength equal to the ultimate tensile strength of the wire. The steel used is normal hard-drawn high-tensile wire; however to insure that a proper nail-head can be cold-formed the carbon content is usually limited to approximately 0.7 percent. Wire in the ultimate tensile range of 100 to 110 tons per square inch is preferred, although this value is by no means critical; diameters are 5 and 6 mm. (0.200 and 0.236 inch).

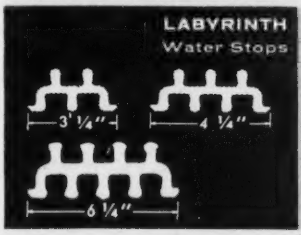
Cables are formed by grouping bundles of wires (from 13 to 42) and passing them through a common an-

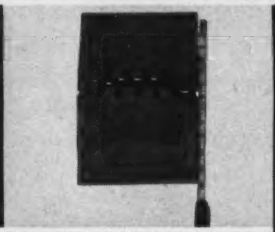
FILE: Prestressing

Look at PROOF of Water Seals' performance!

Here's why they are the Waterstop your jobs deserve

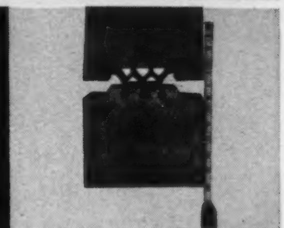
Grueling laboratory tests merely bear out what years of experience on countless jobs have proved: to *stop water* seepage between successive concrete pours, there's no water stop to match Water Seals. Made of the finest polyvinyl chloride resin, Water Seals are unaffected by acids, alkalies, organic chemicals: their bond is sure and water tight even at 150°F and against heads of 200 feet. And they're installed at a fraction of the cost of other types—and much faster. Cut and spliced in the field with a hot knife. Every good water- proof concrete job design should include Water Seals water stops. These pictures show why . . .

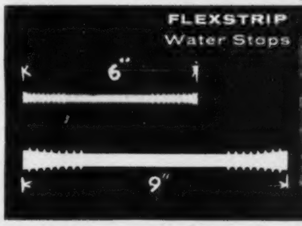




½ in. separation, typical control joint.

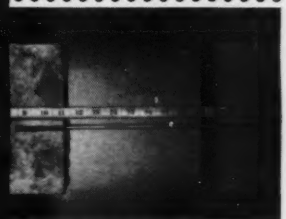
Even after 1½ in. separation, joint seal is assured.

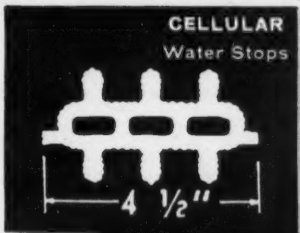


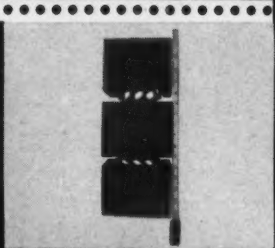


Separation of 2 in., ends are firmly anchored.

Even at 8½ in. separation, corrugated ends still hold firm!

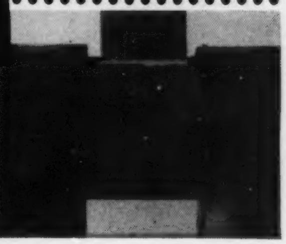






3-rib Cellular joint with 1 in. separation.

½ in. differential: no shearing, bond remains firm.



SEND FOR A SAMPLE SECTION!

Use coupon for sample of type of Water Seals water stop that interests you—and descriptive literature. No charge, of course.

WATER SEALS, Inc.

9 South Clinton Street
Chicago 6, Illinois

WATER SEALS, Inc., Dept. 12
9 South Clinton Street
Chicago 6, Illinois

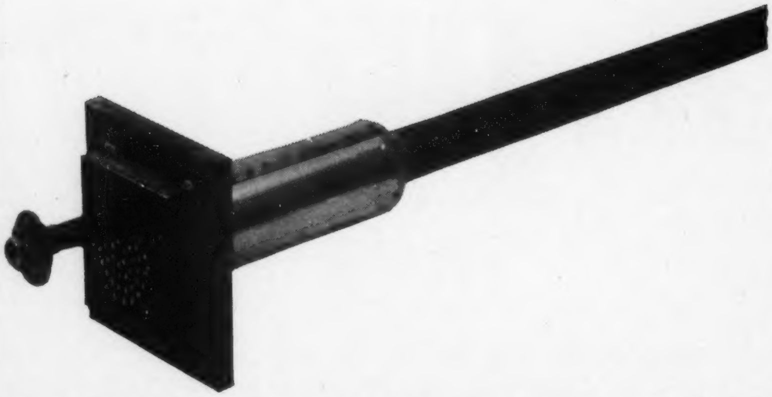
Send samples of ________ type of Water Seals water stop and descriptive literature.

Name________

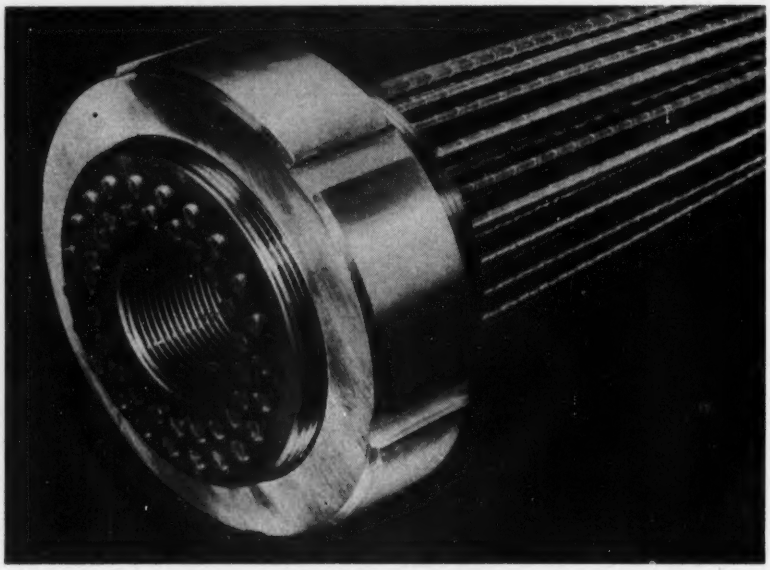
Company________

Address________

City________ Zone____ State________



The fixed end of the prestressing cable; the wires are simply threaded through the bearing plate. The "trumpet" end of the cable sheath is visible; the pipe extension from the bearing plate is to allow grouting.



Close-up of the jacking end of a BBRV cable showing the nail heads on the wires, the anchor head with the central hole for the jack drawbar, and the lock nut.

chor head, after which the wires are nail-headed. Standard cable forces are 28, 56, 90 and 125 tons; the diameters of the ducts required vary from 1⅜ inches to 2⅜ inches according to the size of the cable.

The standard anchorage used at the jacking end of the cable consists of a cylindrical block (the anchor head) having two concentric rings of holes for the wires and a central threaded hole for the draw bar used in tensioning. This block is threaded externally to accommodate a lock nut which transmits the prestressing force to a bearing plate cast in the end of the beam. At the fixed end of the cable the cylindrical block and locking nut are dispensed with and the wires are simply anchored by their nail heads, by threading them through the bearing plate.

Cables are tensioned by means of a 100- or 150-ton hydraulic jack. Extension is measured from a graduated scale on the surface of the ram; a dynamometer indicates the stressing force with an accuracy of plus or minus 1 per cent.

The system gives a safe anchorage which can be inspected at any time, and there is no danger of slip. Cables can be stressed in stages to suit loading conditions, and any losses in stresses can be recovered before grouting takes place. END

ATTENTION READER!

See Page 33

Because of the many recent requests that have come directly to us for additional information on the articles and new products carried in Concrete Construction, we are reinstating our reader information service.

After you have finished reading this issue, turn to page 33. The information you request will be forwarded promptly.

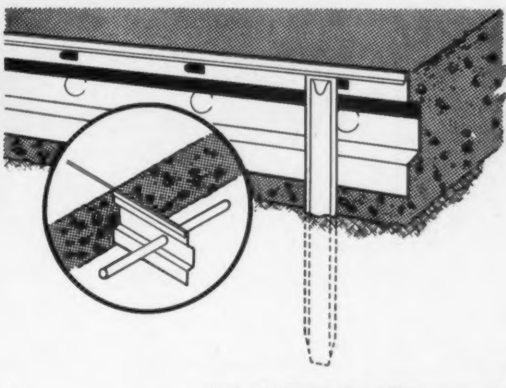
Where can you use a spot... ...or a lot of *colored* concrete?

Do you know that colored concrete has functional as well as aesthetic value? You can use colored concrete to guide traffic, delineate working areas and set off hazard zones. And do you know that Horn coloring products enable you to do this economically?

For example, *Horn Colorundum* is easily dusted on and trowelled into freshly poured concrete—where it assures long-lasting hardness and resistance to abrasion. It's a lime-proof, sun-proof finish. Or you can use *Horn Staybrite.* It's packaged in pre-measured quantities, easily mixed integrally with the cement or mortar—another ideal product which enhances the beauty of all concrete and mortar surfaces.

Like to know more about using colored concrete functionally? Write for details to Dept. CC 125.

A. C. Horn Companies
SUBSIDIARIES AND DIVISIONS
Sun Chemical Corporation
750 Third Avenue, New York 17, N. Y.



BURKE
U. S. PAT. NO. 2848929

Keyed Kold Joint Forms

A new concrete construction product that serves as form, screed, and true cold joint, left permanently in the concrete floor slab. The use of Keyed Kold Joint eliminates spalled joints... produces a cold joint structurally sound and architecturally beautiful. Keyed Kold Joint also eliminates costly make-up and stripping of split forms for checkerboarding. Saves up to 35% in cold joint form costs... results in neater, uniform joints.

W. J. BURKE & CO.

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PLEASE SEND BOOKLET ON KEYED KOLD JOINT FORMS
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SAFETY IN STRENGTH

news

dual bidding on 20-story apartments shows economy of concrete frame compared with steel

Each of nine general contractors bid twice on three 20-story apartment houses for the New York City Housing Authority—once on a concrete frame and once on a steel one. All found concrete cheaper.

This was the result of comparative bidding on the Woodrow Wilson Housing Project in New York City, carried out by the Authority in an effort to determine the relative economy of concrete vs. steel structural frames. When the bids were opened they showed concrete construction to be 8 to 20 percent less than steel. The average ($3,809,000) concrete bid was $508,000 (13 percent) less than the average ($4,317,000) bid for the steel frame.

The $3,626,000 winning bid for concrete construction went to the joint bidders, Leon de Matteis Construction Corporation and Leon de Matteis & Son, Inc., of Elmont, Long Island. Their concrete bid was $510,000 (13 percent) below their bid for the steel design and includes excavation, concrete construction and other work, with the exception of the mechanical work and landscaping. Dic Concrete Corporation of Elmont, L. I., one of several subcontractors who bid the concrete work for the winning combine, was awarded the concrete sub-contract.

"The opportunity to compare two different materials for the same structural purpose," Admiral J. J. Manning, Managing Director of The Concrete Industry Board, Inc., pointed out, "is a rare one. It points up the relative merits and economy of concrete over steel. Because each contractor bid on both designs, some very interesting facts, favorable to concrete, show up from studying the published bids."

Large savings, averaging $508,000, in the use of concrete over steel were shown by each of the nine bidders. Two bidders calculated that concrete cost $731,000 (20 percent) less than steel.

The four lowest concrete bids were all within one percent of each other.

The foundations for the concrete design cost an estimated $30,000 less than those for the steel design, in spite of the fact that the all-concrete buildings are heavier. The need for less materials, because of lower column loads in the concrete design, is one explanation.

The prime contracts for the electrical work and the plumbing were also lower for the concrete design than for the steel one.

This fair comparison of the economy of the structural framing in concrete and steel confirms past decisions and justifies the continued use of concrete frames.

These buildings were originally designed in concrete. Subsequently, a group of steel fabricators working with the American Institute of Steel Construction, Inc., offered to underwrite

the cost of an independent design, using a structural steel frame. The second design was prepared by the same architect and engineer for which this group paid $62,500. In spite of all efforts to keep the steel cost as low as possible, by using minimum sized steel sections, the result was that the steel design was between $300,000 and $731,000 more expensive, as brought out by each of the nine bids. All New York City's housing projects, with few exceptions, have been concrete frame structures.

Anthony Bertone, chief engineer of Dic Concrete Corporation had this to say: "Bidding in both materials showed us that concrete construction has very distinct advantages. The concrete design required less material for the foundations. Twenty-nine tons of steel reinforcement and 712 cubic yards of concrete were saved in the foundations with the concrete framework design. This came to approximately $30,000, according to our estimate. One reason for the savings is that the uniformly spaced columns support smaller loads. In the steel design, fewer columns are used which are more heavily loaded. Each of the buildings rests on a 4-foot, 3-inch deep concrete mat foundation."

The concrete frame buildings are designed using 5½-inch slabs and are of conventional flat-plate construction. In this design, the concrete floor slabs are made thick enough so that no beams or girders are required. Columns are spaced between 10 and 16 feet apart. The steel design utilized junior beams and girders, taking full advantage of all possible economies. A 2½-inch thick concrete slab is used in this design.

According to Mr. Bertone, the design using a steel framework required 12 pounds of steel per square foot of floor area. He believes that it is not possible to reduce materially the amount of steel required for a building of this type.

The winning electrical and plumbing prime bids were lower on the concrete framework than on the steel design, Mr. Bertone believes, because the concrete building has 6 inches less height between floors. Less material is required for the overall height of the building. Also, less labor is called for with flat-plate construction because of the smaller number of bends required in running the electrical conduit between beams and girders. END

fast erection with site precast concrete panels

The 7- by 15-foot concrete panels, here shown being erected to form the exterior walls of a warehouse for the Korhumel Aluminum and Steel Company in Minneapolis, were cast and cured right on the building's previously completed floor slab. Lifting eyes, or hangers, for handling the 6-inch thick panels, were cast in the concrete. After each slab was bolted to the steel framework, its hangers were burned off with a torch. Average elapsed time for lifting and erecting each slab was approximately 5 minutes. General contractor for the project was The Watson Construction Company. The architects were Abbett and Griswold of Minneapolis.

books

1958 Book of ASTM Standards. Part 4. Cement, Concrete, Mortars, Road Materials, Waterproofing, Soils. *Published by American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa. 1456 pp. 338 standards. $12.00.*

Part 4 of the 10-part Book of ASTM Standards covers the production, purchase and evaluation of materials used in the concrete construction industry. A detailed subject index and a list of standards in numeric sequence are included. To keep the book up to date, supplements will be issued late in 1959 and 1960.

Symposium on Some Approaches to Durability in Structures. *Published by American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa. 72 pp. $2.50.*

The durability of structures is a broad subject in which it is obvious that consideration of components of structures in combination and their long life in such combinations are of importance. This symposium does not deal with industrial structural metals but rather with nonmetallic materials that are generally used in structures where weather plays a major part in the durability of the structure.

Since weather as applied to structures must be recognized as both natural and man-made and since both kinds produce factors of exposure that design engineers must cope with, the problems of variations of kinds of exposure and of associated moisture migrations are considered.

This presentation is directed toward correlations between tests of some commonly used structural materials and the effects of weather on them in the hope that future methods of tests for durability will be better understood by structural engineers and by code authorities, both from the standpoint of test limits which indicate unsuitability for a specific structure as well as test limits which indicate unsuitability for a specific structure as well as test limits which may increase costs or be unfair to a supplier because of general considerations rather than specific needs.

letters

Sir:

Because of Frank Lloyd Wright's significant contributions to the use of concrete as an architectural material, your readers might be interested in the following:

To FRANK LLOYD WRIGHT
In Memoriam

His inspiration soared to grasp the form
That transcends form and penetrates across
The realms beyond our earthbound streams—
His sight reached out to bring to life the norm
That mirrors nature and has shed the floss
And fustian of a world of shallow dreams.
Here was a man so sated with the cant
And persiflage of a decaying age
That he reverted back to wood and stone
To gain rebirth . . . and recreate the want
For truth-in-beauty as the primal stage
On which a god could stand, supreme, alone.
Oh, other men left traces, but to die . . .
This dreamer left his footprints in the sky!

LEO LIBERTHSON
Technical Director
L. Sonneborn Sons, Inc.
New York, N. Y.

ready mix history continued

Sir:

It was interesting to read in the January and April issues of *Concrete Construction* the articles on the history of ready mixed concrete.

The following quotation from the *Sheridan Press,* Sheridan, Wyoming, April 4, 1959 describes a portable mixer used in Sheridan in 1909 and may be of interest:

It Happened in Sheridan
50 Years Ago

Cornwall's portable concrete mixer is now at work. The mixer is in the shape of a cube and is constructed upon two wheels with a tongue and is drawn by two horses. It holds about a quarter of a yard of material. The mixer turns over and over as the machine is drawn along by the horses, and in traveling about one block the contents are more thoroughly mixed than can be done by hand and with a great saving of time and labor.

As a supervising engineer for architects for many years, I have been very interested in the development of ready mixed concrete. I am now on your mailing list through the Helena Sand & Gravel Company of Helena, Montana. I am employed by Orr Pickering & Associates of Billings, Montana, and am at work on the new Union Bank Building job here in Helena at the present time.

JOSEPH KUZARA
118 Gem Street
Helena, Montana

architect identified

Sir:

In your April issue (page 6) you printed an article on natural concrete in which you referred to a Norwegian architect. He is E. Viksjo of Oslo and you might be interested to know that he used Colcrete mixers and pumps for the structure mentioned. We are exclusive licensees for this process in the United States.

A. A. STYNER
President
Colcrete Structures, Inc.
New York, N. Y.

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Firm ____________________

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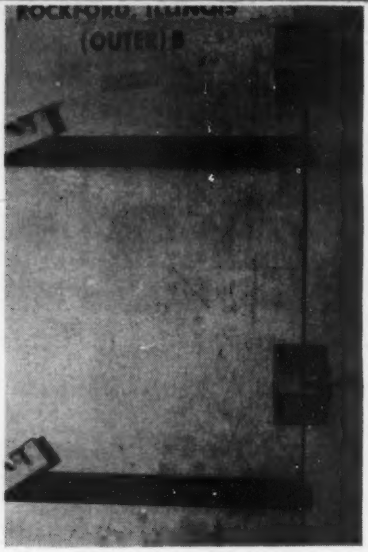
City ____________ Zone ______

State ____________________

Please check: ☐ Concrete Contractor ☐ General Contractor
☐ Engineering ☐ Architecture ☐ Ready-Mix Producer

Other ____________________



☐ tie plates

Simplex tie plates may be used to stack panels horizontally when up to 2 feet of extra form height is required. Panel edges notched to allow the insertion of tie wires and tie plates then slipped over the tie wires and nailed into place. In this position, hardware locks tie wires firmly and provides rigid support for the horizontally stacked panels. Tie plates said to be ideally suited to the 4-foot wide panels used in swimming pool forming. Simplex Forms System, Inc.

☐ index of American standards

1959 price list and Index of American Standards lists more than 1800 American Standards approved to date by the American Standards Association. Available free on request. American Standards Association.

☐ concrete additive

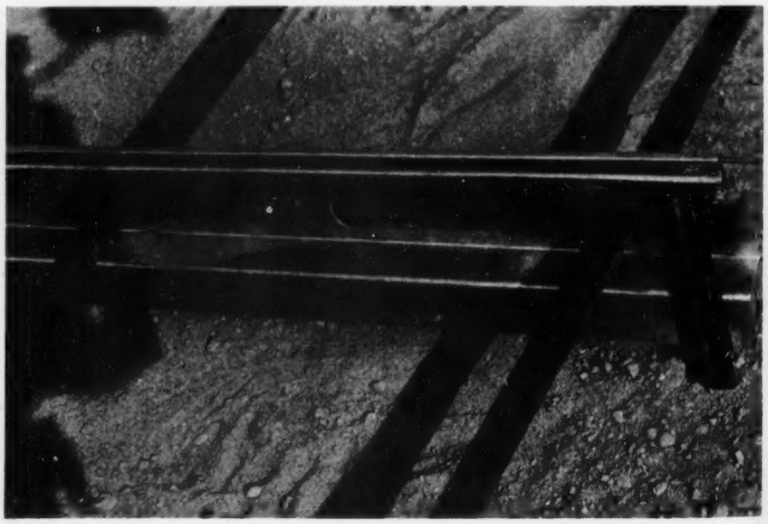
A folder in question and answer form with a foreword devoted to a history of the development of the Berylex formula, gives detailed answers to many questions concerning this chemical cementing compound. Its effect on ultimate strength, high early strength, dusting, wear and acid resistant concrete surfaces, colored concrete, concrete for tilt-up work, and many other subjects are covered in the folder. Berylex National Sales, Division of Harry Warde and Company, Inc.

☐ coupling action bonds concrete

Liquid resin bonding agent joins concrete surfaces permanently when mixed with portland or Lumnite cement mortar and applied as thin grout. Adhesive exhibits coupling action which forms a joint stronger than original material, even when patch is drawn to feather edge. Grout will not soften when immersed in water. Resists actions of heat, cold, oil, gasoline, and most acids. Will bond concrete to other concrete, whether old or freshly placed, also to glass, wood, metal or tile. In patching with Daraweld, concrete surface is cleaned with acid and rinsed with detergent. No chipping and scarifying. Then mortar is scrubbed on surface with brush. Dewey and Almy Chemical Div., W. R. Grace & Co.

☐ joint form

Galvanized sheet metal strip in keyed tongue and groove shape provides form, screed, and cold joint which remains in slab. Holes on 6-foot centers allow #10 wire to be inserted in 12-inch lengths for lapping immediately after placing concrete. Kold Joint Form eliminates installation and stripping of forms and is said to provide better joints. W. J. Burke & Co.



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Title________________

Firm________________

Street Address________________

City________________ Zone________

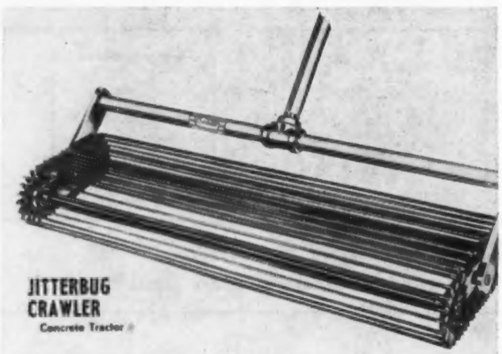
State________________

Please check: ☐ Concrete Contractor ☐ General Contractor ☐ Engineering ☐ Architecture ☐ Ready-Mix Producer

Other________________

☐ solves concrete placing problem

Picture shows placing concrete for reinforced columns with special No. 34 Lad-E-Vator with 4½-cubic foot dumping scoop, top section 15 feet under curve, automatic stop and standard carriage. Portable frame, support and receiving hopper were built by the contractor. Job involved about 180 columns. Unique use of the Lad-E-Vator achieved important savings in cost of placing concrete. Campbell Equipment Co.

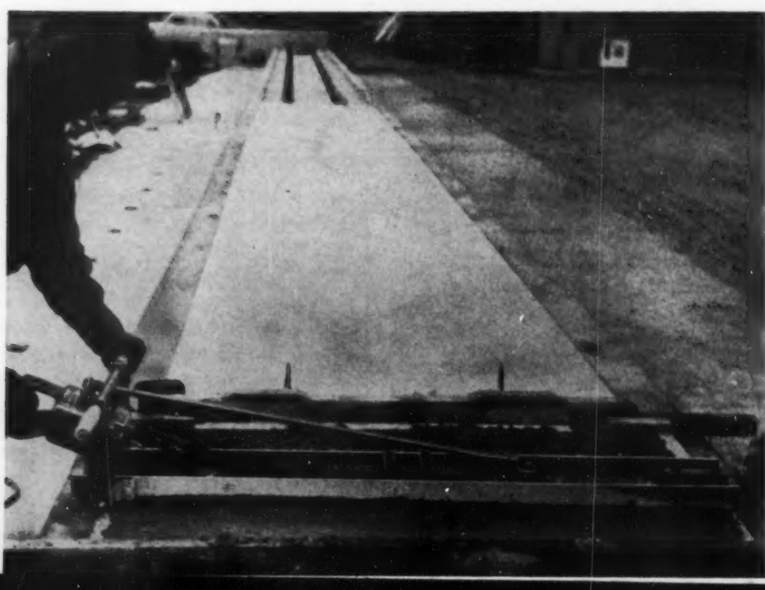


☐ jitterbug crawler

Basic function of this tool is to depress larger aggregate below slab surface and bring thin layer of paste and fine aggregate to surface for quick, easy finishing. No hand beating motion and wading in mix are required in tamping—rods drop straight down into mix as operator pushes crawler. Goldblatt Tool Co.

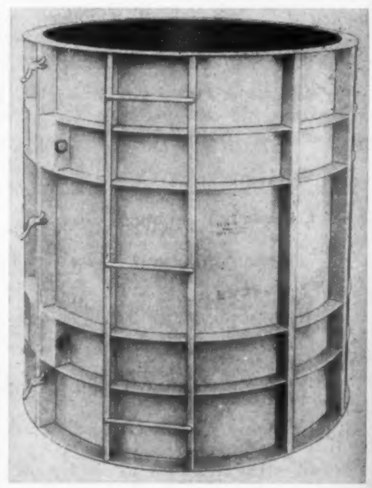
☐ lightweight vibrating screed

A lightweight vibrating screed designed for striking off narrow spans. Easily lifted over any obstructions as it is moved along prestressed beams. Consists of a Stow DU vibrator with ¾-HP motor and 1¼-inch head mounted on aluminum or steel channel with handles on each end. 9,000 to 12,000 vibrations per minute transmitted evenly throughout the beam directly to the concrete. Not only strikes off concrete but it vibrates it at same time. When not in use as screed vibrator can be unbolted and used for vibrating concrete in narrow forms. Available in 4-, 5-, 6-, and 7-foot lengths. A 4-foot DUS screed weighs 47 pounds with an aluminum beam and 77 pounds with a steel beam. Stow Manufacturing Company.



☐ watertight masonry

Citing good workmanship and a minimum of cracks between brick and mortar as the principal prerequisites to watertight masonry, a 6-page Master Builders Company bulletin, O. M.-8A, outlines major considerations in designing tight masonry walls. The bulletin describes the role played by Omicron Mortar-proofing in providing a cohesive plastic mortar to aid good workmanship and its positive water reduction to minimize shrinkage and cracking. Mortar ingredients and proportioning, compatibility of brick and mortar, control of shrinkage and bleeding, separation cracks, effect of mechanical disturbance, and the importance of proper protection are discussed. The Master Builders Co.



☐ bridge column forms

Designed primarily for use in bridge and overpass construction, Efco Bridge Column Forms are for all types of heavy construction where sturdy columns are needed. Combined with regular Efco forms for pier sides, they may be used for forming pier nosings. Forms available in variety of sizes. Efco plate clamps used on both horizontal and vertical joints. Clamps used vertically are for fast erection only, saving crane time. After crane has been moved to other work bolts placed and tightened to provide full strength of form design. To strip, crane simply lifts off form vertically like a sleeve. Economy Forms Corporation.

Ready-Mixed CONCRETE around the home

* DRIVEWAYS

Concrete driveways improve the appearance of your home and last indefinitely. They provide a convenient, safe play area for children, keeping them off the street, and give years of dependable, maintenance-free service.

* SIDEWALKS

Concrete sidewalks increase the value of your property as well as add to the appearance of your home. Using Ready-Mixed Concrete assures you a controlled quality concrete, mixed especially for your particular job.

* PATIOS

Why not enjoy outdoor living with your family at home! A small, modern patio adds charm and beauty and takes only a minimum of space. Ready-Mixed Concrete assures a uniformly strong, weather-resistant patio floor which will provide a lifetime of service and enjoyment.

* STEPS

Concrete steps have a nonslip surface easy to keep clean in all kinds of weather. They need no painting, saving you the cost of maintenance. Saved too are repair costs, for concrete steps will not rot or be weakened by termites

YOUR LOCAL PRODUCER OF READY-MIXED CONCRETE